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while the Mawson plates show a difference of 24·7. Taking this interval as $1^m{\cdot}5$, the change in diameter for $1^m{\cdot}0$ in an Ilford or Rocket plate is 13·9, and in a Mawson plate 16·5.

§ 12. When the figures given in Table III. are rearranged for the different kinds of plates used, and in order of number and date as in Table I., it is seen that the differences of diameter for one magnitude or the parameters for the plates are very constant. There are very few cases in which the data would give them as outside the limits 13 to 15 for Ilford and Rocket plates, or 15 and 18 for the Mawson plates. This is very satisfactory, as it means that there is only one constant to be determined for each plate, and the determination of magnitude from diameter is thus rendered more certain.

Observations of Mars during the Apparition of 1898–99.

By the Rev. T. E. R. Phillips.

Observations of *Mars* were commenced at Yeovil at the beginning of September and continued till the end of April. On the whole the apparition was a tolerably favourable one, despite the smallness of the planet's disc, the number of nights when useful observations could be made showing a decided increase on the corresponding number during the previous apparition.

The powers usually employed were 217, 279, and on a few really good nights 342 on a 9¼-inch silvered glass Newtonian reflector.

In the following notes, after a brief discussion of the polar regions, the various features of the disc are dealt with in four sections, according to longitude. The nomenclature adopted is that of Signor Schiaparelli.

1. *Polar Regions.*

Throughout the apparition the N. Pole was presented to the Earth, the latitude of the centre of the disc about the time of opposition being approximately +12°.

N. Polar Cap.—This cap was very large and intensely bright. At times it appeared to have a slightly bluish colour, probably the effect of contrast with the reddish-ochre tone of the disc. The outline of the cap was fairly regular, and its edge always sharply defined in good air, and generally bounded by a dark blue-grey band. At the close of the observations in April the N. Polar Cap was still a bright and conspicuous object.

S. Polar Cap.—The tilt of the planet's N. hemisphere towards the Earth rendered the cap invisible, but a whitish glimmer was frequently observed illuminating the S. limb.

2. *Surface Markings between Longitudes* 0° *and* 90°.

Fastigium Aryn and *Margaritifer Sinus* were very clearly defined. *Deucalionis Regio* was quite distinct, and *Pyrrhæ Regio*

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well observed on several occasions. The *Mare Acidalium* was very dark, though perhaps scarcely of that inky blackness which rendered it so conspicuous during the previous apparition. *Niliacus Lacus* was well seen, and united with Dawes's forked bay and *Margaritifer Sinus* respectively by the "canals" *Gehon* and *Indus*. *Achillis Pons* was noted in January, but became invisible later.

On March 1 a new lake was detected S.E. of *Niliacus Lacus*, uniting apparently the *Indus* and *Gehon* (fig. 2).

On March 2 and 3 the *N. Polar Cap* seemed to be sharply cut off at its f. end by an extension of the *Mare Acidalium* stretching away in a N.W. direction.

Auroræ Sinus was very dark. The *Jamuna* was usually invisible or exceedingly faint, but on March 1, in good air, it came out as a narrow and well-defined line (fig. 2). The *Ganges* on the whole was less prominent than during the apparition of 1896–97, but became very distinct about the middle of February. *Lacus Lunæ* was dark and fairly definite throughout the apparition.

The "canal" *Nilokeras* often appeared double, but anomalously as during the previous apparition. This does not seem to have been a case of optical gemination, but in all probability there are here two distinct "canals" almost meeting together at the *Lacus Lunæ*. On February 24 the *Nilokeras* appeared as a very broad dusky shading, but well defined and dark on its N. side (fig. 3). *Tempe* was seen intensely white on January 14, perhaps snow or fog.

An exceedingly white spot, fully as bright as the Polar Cap, was seen towards the end of February in about latitude −50°. This spot is evidently to be identified with the island of *Argyre*.

Lacus Tithonius and *Agathodæmon* were very well seen. *Lacus Solis* with rare exceptions was exceedingly difficult throughout the apparition, probably in consequence of the tilt of the planet's axis. The lake was seen best on February 14, when it came out quite clearly at times (fig. 4).

3. *Markings between Longitudes* 90° *and* 180°.

A dusky diffused spot was seen at times at S. end of *Ceraunius*. The f. end of this spot was apparently united with *Propontis* by the "canal" *Pyriphlegethon*. *Propontis* was very dark and clearly separated from the blue-grey band surrounding the N. Polar Cap (fig. 6).

The *Mare Sirenum* was decidedly dark and well-defined, with *Atlantis* quite distinct. *Phætontis* was intensely brilliant, and appeared at times by irradiation to indent the *Mare Sirenum*.

The "canal" *Eumenides-Orcus* was seen on favourable occasions as a very faint straight streak crossing the disc somewhat obliquely. Here and there diffused dusky spots were seen upon it. The most prominent of these was probably *Ammonium*

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at the point where the *Eumenides-Orcus* is crossed by the *Titan.* The *Titan,* though seen occasionally extending N. from *Propontis,* was never traced quite so far as *Ammonium,* being decidedly fainter than during the previous apparition. The *Nodus Gordii* was indicated by a very faint diffused dusky patch best seen on January 4.

4. *Markings between Longitudes* 180° *and* 270°.

The *Trivium Charontis* was a very conspicuous object with the "canals" *Cerberus, Læstrygon, Orcus, Erebus, Hades,* and *Styx* radiating from it. The region between the two latter "canals" was rather darkly shaded, the shading extending right round the N. of *Elysium* to the region of *Aetheria* and the *Boreosyrtis* (figs. 7, 8, and 9). *Elysium* was decidedly white at times, and on a few occasions a brilliant spot was seen immediately f. the *Trivium Charontis.* On February 1 this bright region when at the limb shone with all the intensity of the Polar Cap. The *Galaxias* was well seen once or twice dividing Elysium into two parts. *Hyblæus* was very faint, and appeared to be the boundary line between the whiteness of *Elysium* and the dusky shading of *Aetheria* rather than a definite "canal." The *Cerberus* and *Cyclops* were very broad and dark, especially the former (figs. 8 and 9).

The *Mare Cimmerium* was well defined, with *Hesperia* quite distinct though narrow. *Hesperia* was seen as late as March 14.

Electris was very white at times, especially at the limb.

One of the most remarkable features exhibited by *Mars* during the last apparition was the large dark region in the neighbourhood of the *Boreosyrtis.* A new "lake" was detected here during the apparition of 1896–97, but by last winter this lake had swollen enormously, and was quite a prominent feature of the disc (figs. 9 and 10). *Mare Tyrrhenum* was very dark, even when close to the limb. The *Amenthes,* connecting the *Boreosyrtis* with the *Syrtis Minor,* was very well seen on several occasions.

Hephæstus was very difficult, but appeared occasionally as an exceedingly faint, ill-defined, dusky patch

5. *Markings between Longitudes* 270° *and* 360°.

There was a faint shading between the *Nilosyrtis* and *Boreosyrtis.* This shading was bounded on the west by *Colœ Palus,* and on the east by the unnamed "canal" which came out so prominently during the previous apparition between the N. extremity of the *Syrtis Major* and the *Boreosyrtis.* Last apparition this "canal" lost much of its distinctness, but the *Nilosyrtis* was seen very dark and sharply defined, especially on January 30.

The *Nepenthes* was glimpsed on a few occasions, and on February 1, during an interval of superb definition, a small spot

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was seen upon it, probably at its junction with Thoth (invisible). This spot was again seen on February 2, and is perhaps to be identified with *Lacus Tritonis* (fig. 10). There was a curious "bridge" or rift just N. of the *Astusapes* which appeared to sever the *Nilosyrtis* from the *Syrtis Major* (fig. 11). This was seen distinctly when the seeing was good. The *Syrtis Major* was of a deep blue-grey tone, with at times a tinge of green. It was, as usual, very much darker towards its N. extremity. *Œnotria* was very distinct towards the end of January.

Libya was seen whitish, with a white "bridge" extending from it in a N.W. direction. Another "bridge" was observed running N.E. from *Pharos Insula*; but it was doubtful whether either of them really reach *Hellas* (fig. 11).

Hellas (always seen obliquely) was very white, especially when at the limb.

Sinus Sabæus was very dark, with *Xisuthri Regio* perfectly visible at times, though somewhat difficult.

Edom Promontorium was whitish, and frequently seemed to cast a glimmer of light across the *Sinus Sabæus*, almost severing it from Dawes's forked bay. *Ismenius Lacus*, and the "canals" *Astusapes*, *Astaboras*, *Phison*, *Euphrates*, *Orontes*, *Hiddekel*, and *Gehon*, were all well observed.

Summary.—Apart from the apparent changes caused by the greater tilt of the planet's N. hemisphere towards the Earth, and the diminution of the planet's angular diameter, the features of the disc showed but little alteration from their appearance in 1896–97. The most striking change was the great development of the dark spot seen on the *Boreosyrtis* in 1896.

Another point worthy of notice was the remarkable faintness of the markings near the centre of the disc, between longitudes 100° and 180° approximately. At times this region appeared almost entirely blank, though *Propontis* and the *Mare Sirenum* were decidedly dark.

As regards the so-called "canals," about forty of these objects were seen, or about twenty less than during the previous apparition. The difference is no doubt due to the diminution in the planet's angular diameter. No "canals" were seen certainly double except the *Nilokeras*; but in this case the two components were not parallel, and the writer feels quite convinced of the existence of two separate and distinct "canals." The *Nilokeras*, and the faint line inclined to it at an angle of about 20°, appeared exactly as during the apparition of 1896–97. On one occasion the *Eumenides-Orcus* was for a moment or two doubled, together with the *Trivium Charontis*. The effect, however, was very transitory, and was evidently an optical illusion caused perhaps by the passing of air-waves or by a temporary alteration of the focus of the eye. In poor seeing the "canals" were either totally invisible or were seen as broad, faint, diffused

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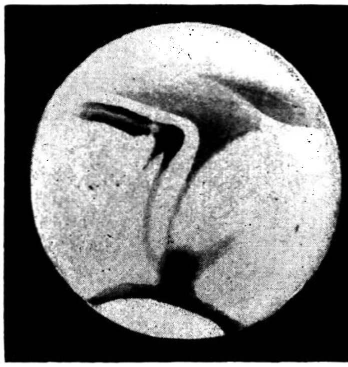
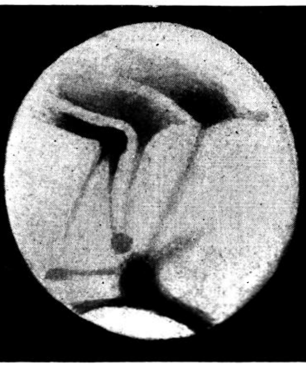
1



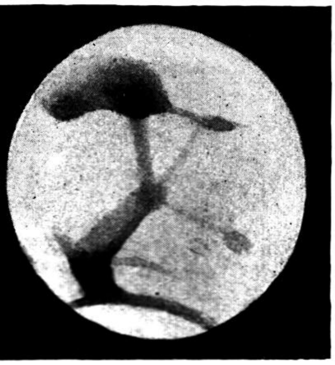
JAN 19.
$\lambda=20^\circ$ $\phi=+11^\circ\cdot5$.

2



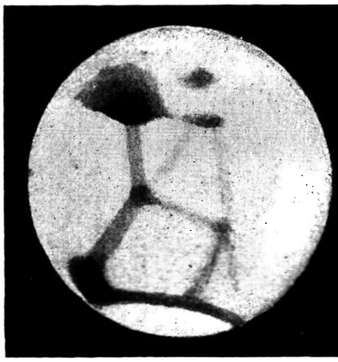
MARCH 1.
$\lambda=32^\circ$ $\phi=+8^\circ\cdot9$.

3



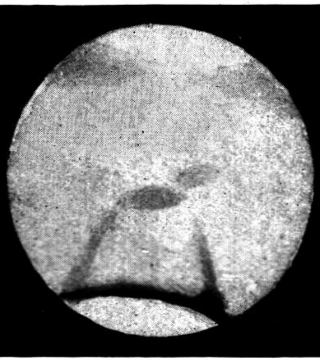
FEB. 24.
$\lambda=62^\circ$ $\phi=+8^\circ\cdot6$.

4



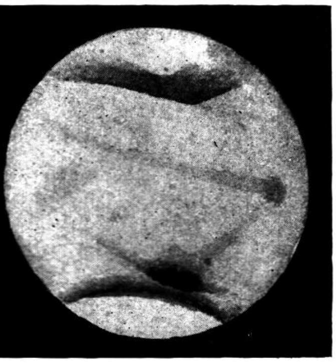
FEB. 14.
$\lambda=91^\circ$ $\phi=+8^\circ\cdot7$.

5



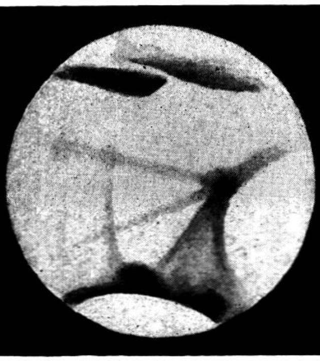
JAN. 8.
$\lambda=118^\circ$ $\phi=+13^\circ\cdot2$.

6



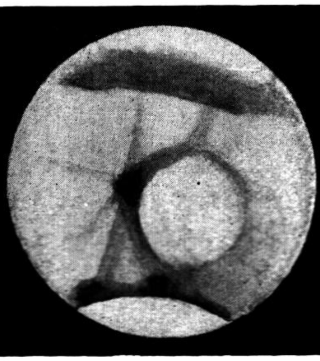
JAN. 4.
$\lambda=153^\circ$ $\phi=+13^\circ\cdot8$

7



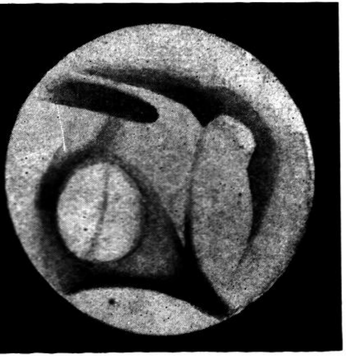
DEC. 31.
$\lambda=180^\circ$ $\phi=+14^\circ\cdot4$.

8



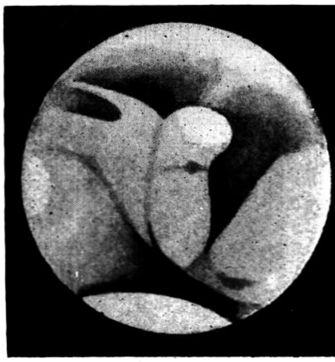
FEB. 1.
$\lambda=210^\circ$ $\phi=+9^\circ\cdot7$.

9



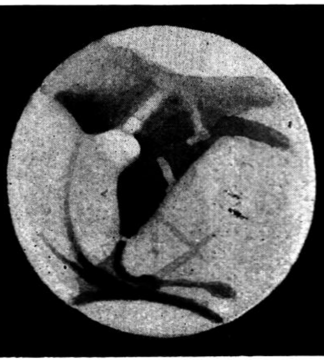
FEB. 1.
$\lambda=243^\circ$ $\phi=+9^\circ\cdot7$.

10



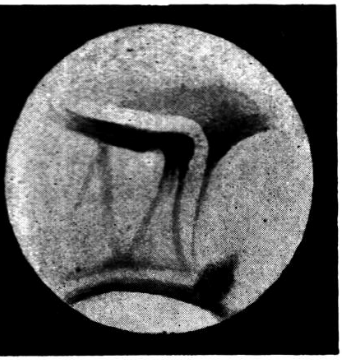
FEB. 1.
$\lambda=272^\circ$ $\phi=+9^\circ\cdot7$.

11



JAN. 30.
$\lambda=301^\circ$ $\phi=+9^\circ\cdot9$.

12



JAN. 24.
$\lambda=357^\circ$ $\phi=+10^\circ\cdot7$.

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streaks. In really good air they were much narrower and darker, and in some cases very definite and sharply defined.

No bright projections were seen either at the limb or terminator. Bright regions like *Argyre*, *Phætontis*, &c., &c. appeared at times to project slightly beyond the limb, but such effects were clearly ordinary irradiation phenomena.

During the apparition thirty-six whole disc drawings were made, twelve of which are reproduced on the accompanying plate (Plate 3).

Observations of Jupiter and his Satellites made at Mr. Crossley's Observatory, Bermerside, Halifax, during the Opposition 1898–99. By Joseph Gledhill.

The following observations of the physical features presented by the planet *Jupiter* during the opposition 1898–99 were made with the 9-inch Cooke Equatorial Refractor (photo-visual), and a Simms parallel-wire micrometer. The negative eye-pieces generally used had powers of 240 and 330; the power used with the micrometer was 280. The observing conditions were very seldom good and the number of clear nights was very small.

The results are arranged under the following heads :—

I. A description of the principal features seen on the disc of the planet.

II. Transits of the dark and bright spots &c. across the central meridian.

III. Measures.

Latitudes of the dark bands.
Widths of the dark bands and bright zones.
Summary 1895–96 to 1898–99.

IV. Notes on the satellites and their shadows.

V. Phenomena of the satellites.

As will be seen from the diagram, the dark bands are numbered 0, 1, 2, 3, 4, 5, 6, 7. Of these 2 and 3 form the